REMARKS/ARGUMENTS

Status of Claims

Claims 1 and 7-13 are pending in the application with claims 1 and 9 being the only independent claims. Claims 2-6 have been canceled without prejudice or disclaimer. Independent claims 1 and 9 have been amended to recite additional claim features, which can be found in original claim 6 and the Abstract. Claims 1 and 9-13 have been amended to conform to U.S. patent practice without narrowing any of the claims or any claim element contained therein.

Reconsideration of the subject application in view of the above amendments is hereby respectfully requested.

Overview of the Office Action

Claims 1, 6-8, and 10 have been rejected under 35 U.S.C. §103(a) as being unpatentable over USP 7,375,757 to Hoshino in view of USP 6,528,889 to Matsuhira.

Claims 9 and 11-13 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Hoshino in view of Matsuhira, and further in view of US Pub No. 2004/0061799 to Atarashi.

Summary of Subject Matter Disclosed in the Specification

The following descriptive details are based on the specification. They are provided only for the convenience of the Examiner as part of the discussion presented herein, and are not intended to argue limitations which are unclaimed.

Portable cameras typically use flip-chip type imaging units. In a flip-chip type imaging unit, a thin FPC (Flexible Printed Circuit) board is provided between an imaging element and a lens focusing light onto the imaging element. The thin FPC board is formed an opening portion allowing incident light to pass through and reach the imaging element. The opening portion however weakens the thin FPC board.

To strengthen such thin FPC boards, stainless-steel plates have been used as reinforcing members. The inventors have determined that high thermal shock load can occur as a result of either internal circuitry operation of the semiconductor device or external environmental factor. For example, when a portable terminal equipment including an imaging element and a stainless-steel reinforcing plate is exposed to direct sunlight in a car, a high thermal shock load can occur to the portable terminal equipment. In these cases, the electrode pads of the imaging elements may peel off and thus damage the equipment.

The present invention provides a solution to the problem caused by a stainless-steel plate when being used to reinforce a thin FPC board in a flip-chip type imaging unit. In the present invention, the reinforcing member (10) is made of a non-metallic material, such as ceramics and glass. As such, the reinforcing member (10) is not turned on electrically, even if an electrode is exposed due to defectiveness of the FPC board. The present invention thus has an advantageous effect that the imaging unit (100) can be used safely.

Moreover, the present invention provides an imaging unit (100) that is thermal shock resistant and has increased durability. According to the claimed invention, the reinforcing member (10) is made of a material having a linear expansion coefficient that is equal to or less than 1×10^{-5} (cm/cm/°C). *See*, original claim 6 and the Abstract. By using a material having a linear expansion coefficient of equal to or less than 1×10^{-5} (cm/cm/°C), the electrode pads of the imaging elements 2 can be prevented from peeling off, even when a strong thermal shock load occurs. Therefore, the imaging unit (100) of the invention can have an improved durability.

Patentability of the Claimed Invention

Independent Claim 1

Independent claim 1 recites "a reinforcing member which is made of a glass or ceramic material having a linear expansion coefficient of 1×10^{-5} (cm/cm/°C) or less." The flip-chip type

imaging unit of the claimed invention is effective for making, for example, a portable camera unit with a compact size.

The above recited claim features are not taught by the cited art because the combination of Hoshino and Matsuhira does not teach or suggest a reinforcing member (i) made of a glass or ceramic material" and (ii) "having a linear expansion coefficient of 1 x 10^{-5} (cm/cm/°C) or less," as is explicitly recited in independent claim 1.

(i)

The cited art does not teach "a reinforcing member which is made of a glass or ceramic material," as is recited in independent claim 1.

When rejecting claim 6, which is now incorporated in independent claim 1, the Office Action states that the metal plate 13 in Hoshino consists of a non-metallic material such as glass or ceramics. Applicants disagree.

Hoshino discloses a flip-chip type imaging apparatus, in which the substrate 10 is formed by joining a flexible wiring board 4 with a metal plate 13, which provides sufficient strength to the substrate 10 (*see*, *e.g.*, column 3, lines 38-40 and 48-51). In the Examiner's cited portions of Hoshino, Hoshino teaches an example where the metal plate 13 is not needed when the thickness of the flexible wiring board 4 is increased to provide sufficient strength. In such a case, all or part of the substrate 10 can be made of ceramics or glass type material (*see*, *e.g.*, column 4, lines 2-5).

Nowhere in Hoshino does it teach that the metal plate 13 can be made of a non-metallic material, when the metal plate 13 is used together with the flexible wiring board 4. The discussion about the ceramics or glass type material in the cited portions of Hoshino is made in connection with an example where the metal plate 13 can be left out. In such an example, the substrate 10 consists of the flexible wiring board 4 with sufficient rigidity. The plate 13 in

Hoshino, if required, is otherwise a metal plate 13. Hoshino thus teaches no more than a conventional technique, which the claimed invention seeks to improve.

Moreover, Hoshino does not discuss the problem that the electrodes between the imaging element and the FPC board may peel off after a thermal shock load when a stainless-steel plate is used in the imaging apparatus. Independent claim 1 is thus not obvious over Hoshino.

Matsuhira is cited in the Office Action for the alleged teachings concerning the linear expansion coefficient of the claimed reinforcing member. The adhesion-reinforcing pattern 3 of Matsuhira is made of Sn or Au and formed by plating the circuit board. *See*, column 3, lines 8-11. Therefore, Matsuhira does not cure the deficiencies of Hoshino.

Accordingly, independent claim 1 patentably distinguishes over Hoshino and Matsuhira for at least the above reasons.

(ii)

The cited art does not teach "a reinforcing member ... having a linear expansion coefficient of 1×10^{-5} (cm/cm/°C) or less," as is recited in independent claim 1.

The Office Action acknowledges that Hoshino does not teach the above recited claim features of independent claim 1 and cites Matsuhira for its alleged teachings concerning the linear expansion coefficient. Applicants submit that Matsuhira does not cure the deficiencies of Hoshino for the following reasons: (a) the linear expansion coefficient disclosed in Matsuhira is that of the whole substrate, rather than of the adhesion-reinforcing pattern 3 which is interpreted in the Office Action as a reinforcing member, and (b) one skilled in the art will not apply the teachings of Matsuhira's adhesion-reinforcing pattern 3 to Hoshino, as suggested in the Office Action, because Matsuhira teaches away from the claimed invention by suggesting to increase the adhesion force and consequently the linear expansion coefficient of the substrate and because

Matsuhira's adhesion-reinforcing pattern 3 is not "a reinforcing member ... attached to the other side of said circuit board to reinforce said circuit board," as is recited in independent claim 1.

Matsuhira discloses an electronic circuit device including a circuit board having a pattern 2 and an adhesion-reinforcing pattern 3 (*see*, Fig. 1). The adhesion-reinforcing pattern 3 is formed on a substrate 1 to improve the adhesion of the IC 4 to the circuit board. In Matsuhira, the adhesion-reinforcing pattern 3 leads to an increase of the linear expansion coefficient of the circuit board to 9.9 x 10^{-6} (cm/cm/°C) (*see*, *e.g.*, column 2, line 63 to column 3, line 7). The linear expansion coefficient disclosed in Matsuhira however is that of the whole substrate, including the pattern 2 and the adhesion-reinforcing pattern 3. There is no teaching in Matsuhira concerning the linear expansion coefficient of the adhesion-reinforcing pattern 3 alone. Therefore, Matsuhira does not teach the above recited claim features of independent claim 1.

Accordingly, even if Matsuhira is combined with Hoshino as suggested in the Office Action, the combined art does not teach "a reinforcing member ... having a linear expansion coefficient of 1 x 10^{-5} (cm/cm/°C) or less," as is recited in independent claim 1. The claimed invention is thus not obvious over Hoshino and Matsuhira for at least the above reasons.

Moreover, one skilled in the art will not combine Matsuhira with Hoshino to arrive at the invention recited in independent claim 1. Matsuhira discloses the use of an adhesion-reinforcing pattern 3 to increase the adhesion force between the IC and the circuit board and hence improve reliability of the device. In other words, Matsuhira suggests that it is desirable to increase the adhesion force and consequently the linear expansion coefficient of the substrate, and thus teaches away from the claimed invention. Therefore, it is not obvious for one skilled in the art to look to such teachings of Matsuhira to arrive at an imaging unit of thermal shocks-resistant of the claimed invention. The claimed invention is thus not obvious over Hoshino and Matsuhira for the above additional reasons.

Furthermore, Matsuhira fails to teach or suggest anything about a reinforcing member that reinforces a circuit board. The adhesion-reinforcing pattern 3 in Matsuhira merely imposes adhesion between the IC and the circuit board and does not reinforce the circuit board, as does the reinforcing member recited in independent claim 1. Therefore, one skilled in the art will not be motivated to apply teachings of Matsuhira's adhesion-reinforcing pattern 3 to modify Hoshino's metal plate 13 in order to arrive at the "linear expansion coefficient of 1 x 10^{-5} (cm/cm/°C) or less" as recited in independent claim 1. The claimed invention is thus not obvious over Hoshino and Matsuhira for the above additional reasons.

In view of all the above, independent claim 1 patentably distinguishes over Hoshino and Matsuhira for the above additional reasons. Withdrawal of the rejection of independent claim 1 is requested.

Independent Claim 9

Similar to claim 1, independent claim 9 recites "a reinforcing member which is made of a glass or ceramic material having a linear expansion coefficient of 1 x 10^{-5} (cm/cm/°C) or less."

Atarashi is cited in the Office Action for the alleged teachings concerning cutout portions 15 and does not remedy the deficiencies of Hoshino and Matsuhira. Therefore, independent claim 9 is allowable for at least the same reasons that independent claim 1 is allowable.

Dependent Claims 7-8 and 10-13

Claims 7-8 and 10-13 depend, directly or indirectly, from allowable independent claim 1 or 9. Therefore, claims 7-8 and 10-13 are each allowable for at least the same reasons that independent claim 1 is allowable.

In addition, claims 7-8 and 11-13 include features which serve to even more clearly distinguish the claimed invention over the prior art of record.

Conclusion

Based on all of the above, it is respectfully submitted that the present application is now in proper condition for allowance. Prompt and favorable action to this effect and early passing of this application to issue are respectfully solicited.

Should the Examiner have any comments, questions, suggestions or objections, the Examiner is respectfully requested to telephone the undersigned in order to facilitate reaching a resolution of any outstanding issues.

Respectfully submitted,
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